

Southwest Fisheries Science Center
P.O. Box 271
La Jolla, California 92038

January 8, 2002

CRUISE REPORT

VESSELS: NOAA Ships *David Starr Jordan* and *McArthur*

CRUISE NUMBERS: DS-01-05 and AR-01-05
SWFSC Marine Mammal Cruise Numbers 1617 and 1619

CRUISE DATES: 30 July – 8 December, 2001

PROJECT: Oregon, California and Washington Line-Transect Expedition 2001
OR.CA.WA.L.E.

SPONSOR: NOAA, NMFS, Southwest Fisheries Science Center (SWFSC)
Protected Resources Division (PRD)

Chief Scientist: Dr. Jay Barlow, SWFSC (858) 546-7178

ITINERARY:

NOAA Ship *David Starr Jordan*:

LEG 1: Depart: 30 July – San Diego, CA	Arrive: 17 August – Newport, OR
LEG 2: Depart: 30 August – Portland, OR	Arrive: 16 September – Eureka, CA
LEG 3: Depart: 19 September – Eureka, CA	Arrive: 04 October – San Diego, CA
LEG 4: Depart: 08 October – San Diego, CA	Arrive: 27 October – Astoria, OR
LEG 5: Depart: 01 November – Astoria, OR	Arrive: 10 November – San Diego, CA

NOAA Ship *McArthur*:

LEG 6: Depart: 15 November – San Francisco, CA	Arrive: 8 December – San Diego, CA
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Cruise Description and Objectives: The ORCAWALE 2001 cruise was a marine mammal assessment survey of the U.S. West Coast waters out to a distance of approximately 300 nautical miles. The overall objective of the ORCAWALE cruise was to estimate the abundance and understand the distribution of dolphins, whales and porpoise that are commonly found off of the West Coast. In addition, biological and oceanographic data were collected to better characterize the animals' environment. Other objectives included acoustic sampling, biopsy sampling and photo-identification.

STUDY AREA:

The area covered was U.S. West Coast Exclusive Economic Zone (EEZ) of Washington, Oregon, and California and international waters out to a distance of approximately 300 nautical miles from the coast. The survey was a grid of predetermined tracklines to uniformly cover this offshore area. Actual tracklines covered are shown in Figure 1.

1 PROCEDURES FOR DAYLIGHT OPERATIONS

1.1 Cetacean Survey - Line-transect survey methods were used to collect abundance data. At the beginning of each day search effort began on the trackline. The *Jordan* and *McArthur* traveled at 7 - 10 knots (through the water) along the designated trackline. A daily watch for marine mammals was maintained during daylight hours by scientific observers on the flying bridge (approximately 0600 to 1900), except when the ship was stopped to conduct other sampling operations, or when precluded by weather. A team of three observers searched with 25x150 binoculars, 7X binoculars, and unaided eye. Sighting conditions, watch effort, sightings, and other required information were entered into a portable computer, hooked up to the ship's GPS (for course, speed and position information). Intermittently, an "independent observer" kept a separate watch of animals sighted during the cetacean survey operations, which will be compared with the observer team's data.

1.1.2 Breaking Trackline - On sighting a marine mammal school or other feature of biological interest, the Cruise Leader or marine mammal observer team on watch often requested that the vessel be maneuvered to approach the school or feature for investigation. When the ship approached a school of dolphins, the observers made independent estimates of school size. When possible, biopsy and photographic operations commenced from the bow, based on directions from the Cruise Leader or identification specialists. In some instances, the Cruise Leader requested the deployment of a small boat for biopsy, photographic or other operations (see 1.1.6).

It was occasionally necessary to divert the ship's course from the established trackline during regular effort due to glare or adverse sea conditions. Under these circumstances, the ship diverted up to 30 degrees from the established course, per established method in cruise instructions in which "such deviations may continue until the ship is 5 nm from the trackline, at which point the ship must turn back toward the trackline."

1.1.3 Sperm Whale Studies - Special methods were used with sperm whales to ensure complete group size estimates for this long-diving species. Groups of sperm whales were typically observed for 90 minutes whenever possible. Estimates of group size were made after 10 minutes, 60 minutes, and 90 minutes to see how estimates change with observation time. Subgroups were tracked and dive times were recorded using the program SpermCount on the seabird observer's computer.

1.1.4 Resuming Effort - When the observers completed scientific operations for a sighting, the ship resumed the same course and speed as prior to the sighting. If the pursuit of the sighting took the ship more than 5 nm from the trackline, the observers were notified. In those cases, the Cruise Leader or identification specialists requested that, rather than proceed directly toward the next waypoint, the ship take a heading of 20 degrees back toward the trackline.

1.2 Seabird Survey - Seabird and pinniped observations were conducted concurrently with cetacean observations using strip transect methods. A single observer recorded identity and behavior for all seabirds and pinnipeds within 300 m of one forequarter of the ship. Animals were detected with unaided eye; hand-held binoculars were used to confirm species identification.

1.3 Conditions Which Preclude Normal Operations - At times during the cruise, visual survey operations were not possible due to high winds, seas, or fog. Usually, survey operations were suspended at Beaufort Sea State 6 or higher. Also, if fog made the visibility one nautical mile or less, visual observations were suspended until visibility increased to over 1 NM. During these times, the Cruise Leader decided which task to pursue, if any other operations were possible. The Cruise Leader informed the bridge when survey effort was suspended. See Table 6 for a summary of full days lost to weather.

1.4 Acoustics - Towed Array (*Jordan* only)- A hydrophone array was towed during daylight hours to record cetacean vocalizations. The array was deployed each morning, prior to the start of visual observations, and retrieved each evening after search effort ended (and whenever increased maneuverability was required). The array and cable were wound onto a hydraulic-powered aluminum winch supplied by SWFSC. A team of two acousticians monitored the array, recorded sounds made by cetaceans, localized their positions, and was responsible for deployment and retrieval of the array, including operation of the winch.

1.4.1 Retrieval of the Array (Reasons) - The array was deployed during daylight hours every day unless the Cruise Leader (or Commanding Officer) determined that greater maneuverability was required. Some reasons for retrieval of the array were: 1) situations/emergencies that required the ship to be able to maneuver without restriction; 2) a full stop of the ship (*i.e.*: to launch a small boat or collect respiration data on sperm whales); 3) repeated 180 degree turns (*i.e.*: running repeatedly through dolphin schools to collect biopsy samples); or 4) operating in close/restricted waters with a requirement to be able to maneuver freely; or 5) presence of fishing gear in the waters.

1.4.2 Retrieval of the Array (Procedure) - The array was retrieved at full speed when necessary, however, the routine evening retrieval was done at half speed.

1.5 Acoustics – Other - The scientific EK-500 depth sounder on *Jordan* and the EQ50 on *McArthur* were operated by the oceanographer, at 38 and 200kHz, to estimate micronekton biomass between 0 and 500 m. They ran continuously (day and night). However, this schedule of operation was changed at the discretion of the Cruise Leader. The vessel's EQ-50 depth sounder was used at the discretion of the Commanding Officer, but normally remained off while underway, except when navigating in waters less than 100m. The ship informed the Cruise Leader of any use of the vessel's EQ-50, as it had potential to interfere with the signals received on the EK-500. The scientific EQ-50 was the backup for the EK-500, but was not used on *Jordan*.

1.5.1 ADCP (*Jordan* only) - The ship's ADCP ran continuously and was logged to a data acquisition system. Complete system settings were provided by the oceanographer, including 5-minute averaging of currents, AGC and 4 beam returns in 60 8-meter bins.

1.5.2 Sonobuoys - Sonobuoys were deployed periodically to record sounds from whales and dolphins from either the ship, or a small boat on an opportunistic basis, at the discretion of the Cruise Leader. With the exception of the small boat, all of the necessary equipment was supplied and operated by scientific personnel.

1.6 Small Boat Work - A small boat was deployed as necessary for biopsy sampling, photography and deployment of sonobuoys. Deployment of the small boat was requested by the Cruise Leader on an opportunistic basis, often multiple times in a single day, providing the Commanding Officer concurred that operating conditions were safe.

1.6.1 Biopsy Sampling - Biopsies for genetic analyses of marine mammals were collected on an opportunistic basis. Necessary permits were aboard the vessel. The animals sampled were either approached by the research vessel during normal survey operations, approached the vessel on their own, or were approached by a small boat. Samples were collected from animals within 10m to 30m of the bow of the vessels using a dart fired from a crossbow or a dart rifle.

1.6.2 Photography - Photographs of marine mammals were taken on an opportunistic basis. Necessary permits were present on the vessel. The animals photographed were either approached by the research vessel during normal survey operations, approached the vessel on their own, or were

approached by a small boat.

1.7 Collection of Fish - Fish were collected on an opportunistic basis at the discretion of the Cruise Leader. While underway, trolling gear was used when conditions permitted, and if fishing did not interfere with the towed hydrophone array. While stationary, hook-and-line gear was used.

1.8 Collection of Marine Mammals - Marine mammal body parts were collected on an opportunistic basis at the discretion of the Cruise Leader. Permits to collect and import marine mammal parts were present on the vessel.

1.9 Oceanography - Oceanographic sampling was done by the oceanographer and other designated scientists while underway during the day. See Oceanographic Summary, Table 4.

1.9.1 XBT Drops - There were 4 XBT drops per day at 0900, 1200 and 1500 hours local ship time, and the fourth just prior to the evening net station. If the vessel was stopped, the drop was done when the vessel was again underway. If the vessel was not going to move within half an hour, the scientist performing the drop was notified and the drop delayed or canceled, at the discretion of the Cruise Leader.

1.9.2 Surface Water Samples - A surface water sample for chlorophyll *a* analysis and a bucket temperature were taken at 0900, 1200, 1500, and 1800 hours local ship time daily.

1.9.3 Thermosalinograph Sampling - The ships provided and maintained a thermosalinograph (TSG), which was calibrated and in working order, for continuous measurement of surface water temperature and salinity. A backup unit (calibrated and in working order) was also provided by the vessels, and remained aboard during the cruise. A data acquisition system (WinDACS), furnished and maintained by scientific personnel, was connected directly to the TSG output from the Seabird interface box. This computer (laptop) received the raw data, with the NMEA position string attached to each record. Additionally, the laptop was connected to the ship's LAN, in order to synchronize with the ship's time server. The ship's Scientific Computing System (SCS) also collected this information. The oceanographer provided the ship's Operations Officer and Electronics Technician with detailed acquisition information before departure.

2 PROCEDURES FOR NIGHT OPERATIONS

A chronological record of oceanographic and net tow stations was kept by the ship (Electronic Marine Operations Log) with dates and times in GMT. The *Jordan* provided a digital copy of the electronic marine operations log and cruise weather log via e-mail to the SWFSC oceanographer at the completion of the cruise. The collection of oceanographic data, samples, and their processing was be conducted by the scientific party. The crew of the vessels operated all deck equipment and was responsible for the proper termination (and any necessary reterminations) of the CTD cable pigtail (provided by the scientific party) to the conducting cable of the winch. The ships provided a complete backup system, consisting of frame with weights, 12-place rosette and deck unit, and SeaBird 9/11+ CTD with conductivity and temperature sensors. All instruments, their spares and spare parts provided by the ship were maintained in working order and had current calibrations (within previous 12 months).

2.1 CTD Stations - One CTD (conductivity-temperature-depth) station was occupied each morning before sunrise. CTD data and seawater samples were collected using a SeaBird 9/11+ CTD with rosette and Niskin bottles fitted with silicone tubing and o-rings. All casts were to 1000m (depth permitting) with the descent rate at 30m/min. for the first 100m of the cast, then 60m/min after that, including the upcast between bottles. From each cast, chlorophyll samples (to 200 m) and salinity samples (500 and 1000 m or bottom) were collected and processed on board. Additional salt samples were collected every other day (4

depths < 500m). The 275ml chlorophyll samples were filtered onto GF/F filters, placed in 10ml of 90% acetone, refrigerated for 24 hours, then analyzed on a Turner Designs model 10AU field fluorometer. Nutrient samples (0 - 500 m) were collected, frozen, and stored on board. Cast times were subject to change since sunrise varied during the cruise. Each evening, the Operations or Deck Officer calculated the estimated time (based on sunrise) for the morning CTD.

2.1.1 CTD Samples - The morning cast (1000 m) began approximately one and one-half hours prior to sunrise. This exact starting time was determined the evening before, by the Operations or Deck Officer. Niskin bottle water samples were collected at seven light depths and five additional standard depths, between the surface and 1000 meters. These depths were determined just prior to each cast by entering the ship's position into a computer program. Primary productivity was measured by radioactively labeled carbon uptake methods. The seven samples were spiked with ^{14}C , incubated on deck for 24 hours, filtered, and stored for later analysis at the SWFSC. The Niskin bottles (#1-7) were rinsed after each cast and acid-washed at the end of each leg. In San Diego, the oceanographer was trained by Valerie Philbrick, SWFSC, in the use of radioactivity prior to departure. A copy of the SWFSC's NRC license for use of radioisotopes was kept on board. All radioactive waste was stored in secured drums and returned to San Diego for removal (*i.e.* no disposal of radioactivity at sea).

2.2 Net Sampling: Net tows were conducted by the scientific party with the assistance of a winch operator from the vessel.

2.2.1 Bongo Tow - Bongo nets were towed to a depth of 200m (300 meters of wire out). The bongo tow took place at least 1 full hour after sunset each night. The tow took approximately 30 minutes to complete.

2.3 Transit - When scientific operations were complete for the night, the ship resumed course and proceeded along the trackline, until it was necessary to stop and position the ship for the morning (pre-daylight) CTD station. The ships transited between 0 and 30 nautical miles per night depending on the necessity of the current and predicted weather conditions, and the needed trackline coverage. The Cruise Leader had flexibility to determine this distance, as well as the transit speed on a daily basis, depending on planned scientific operations.

RESULTS:

The visual survey yielded good data for conditions in which the sea state was less than Beaufort 5. A total of 513 cetacean schools were observed (**Table 1**), 24,495 individual seabirds (**Table 2**), and 69 individual pinnipeds (**Table 3**). Environmental data is summarized in **Table 4**.

During legs 1 through 5 the NOAA Ship *David Starr Jordan* covered 7,744 kilometers of on effort trackline, with a high biopsy and photo ID success rate. Daily survey effort varied; some days were lost entirely due to mechanical problems encountered by the ship (**Table 5**) and weather conditions (**Table 6**). In response to the last breakdown suffered by the *David Starr Jordan*, the NOAA Ship *McArthur* started leg 6 early and was able to cover 2,325 kilometers of on effort trackline, increasing coverage and recovering some of the time that would have otherwise been lost. The combined effort of both ships covered the study area uniformly, but did not cover all the planned transects (**Figures 1 and 2**).

Acoustics -Array use varied during the cruise based on weather conditions and equipment malfunctions (**Table 7**). The high frequency 3-element array was preferred during calm sea states for the broadband frequency characteristics until it broke during leg 2. During high sea states, the Norris 5-element array was used, and this became the primary array after the leg 2 equipment failures. The SEFSC array was tested and used briefly during leg 4.

Recordings of visually detected sightings from the towed hydrophone array included vocalizations from short-beaked common dolphins, long-beaked common dolphins, striped dolphins, Pacific white-sided dolphins, northern right whale dolphins, bottlenose dolphins, Risso's dolphin, killer whales, and sperm whales (**Table 8**). No acoustic vocalizations from Dall's porpoise, harbor porpoise, beaked whales or baleen whales were detected with this equipment.

All non-sighted acoustic detections, with the exception of sperm whales, were defined as "unidentified dolphins". There were a total of 65 non-sighted acoustic detections, of which 43 were unidentified dolphins. Sperm whales accounted for 22 of these non-sighted acoustic detections, with all but one of these detections outside of the search range of the visual observers. The acoustic team detected many of the sperm whales that were seen by the visual team and information regarding animal location was relayed to the visual team according to independent detection protocol (after they passed the beam).

A total of 38 sonobuoys were deployed from the ships, including both high frequency 57A low frequency and 53 sonobuoys (**Table 9**). Recordings from two groups of killer whales and one fin whale were obtained from the high frequency sonobuoys (with 3 functional sonobuoys of a total of 13). Recordings of humpback, fin, and blue whales were obtained from the low frequency sonobuoys (with 18 functional sonobuoys of a total of 25). One humpback recording was of a singing animal, the recording appeared to contain a complete song.

SCIENTIFIC PERSONNEL:

Leg 1:

Name¹	Position	Name¹	Position
Jay Barlow	Cruise Leader	Lisa Ballance	Cruise Leader
James Cotton	ID Specialist	James Cotton	ID Specialist
Richard Rowlett	ID Specialist	Richard Rowlett	ID Specialist
Juan Carlos Salinas	Mammal Observer	Juan Carlos Salinas	Mammal Observer
Laura Morse	Mammal Observer	Laura Morse	Mammal Observer
Erin LaBrecque	Mammal Observer	Erin LaBrecque	Mammal Observer
Leigh Torres	Mammal Observer	Leigh Torres	Mammal Observer
Michael Force	Seabird Observer	Michael Force	Seabird Observer
Cornelia Oedekoven	Seabird Observer	Cornelia Oedekoven	Seabird Observer
Candice Hall	Oceanographer	Candice Hall	Oceanographer
Shannon Rankin	Acoustician	Shannon Rankin	Acoustician
Megan Ferguson	Acoustician	Julie Oswald	Acoustician
Annie Douglas	Photo-ID Specialist	Annie Douglas	Photo-ID Specialist
Valerie Philbrick	Oceanographer	Josh Fluty	Visiting Scientist

Leg 2:

Leg 3:

Name¹	Position	Name¹	Position
Barb Taylor	Cruise Leader	Sarah Mesnick	Cruise Leader
James Cotton	ID Specialist	Juan Carlos Salinas	ID Specialist
Richard Rowlett	ID Specialist	Richard Rowlett	ID Specialist
Juan Carlos Salinas	Mammal Observer	Christina Fahy	Mammal Observer
Laura Morse	Mammal Observer	Laura Morse	Mammal Observer
Erin LaBrecque	Mammal Observer	Erin LaBrecque	Mammal Observer
Leigh Torres	Mammal Observer	Leigh Torres	Mammal Observer
Michael Force	Seabird Observer	Michael Force	Seabird Observer
Cornelia Oedekoven	Seabird Observer	Cornelia Oedekoven	Seabird Observer
Candice Hall	Oceanographer	Candice Hall	Oceanographer
Shannon Rankin	Acoustician	Shannon Rankin	Acoustician
Julie Oswald	Acoustician	Tony Martinez	Acoustician
Todd Chandler	Photo-ID Specialist	Todd Chandler	Photo-ID Specialist

Leg 4:

Leg 5:**Leg 6: (on the *McArthur*)**

Name¹	Position	Name¹	Position
Robert Pitman	Cruise Leader	James Carretta	Cruise Leader
James Cotton	ID Specialist	James Cotton	ID Specialist
Richard Rowlett	ID Specialist	Richard Rowlett	ID Specialist
Juan Carlos Salinas	Mammal Observer	Juan Carlos Salinas	Mammal Observer
Laura Morse	Mammal Observer	Laura Morse	Mammal Observer
Erin LaBrecque	Mammal Observer	Erin LaBrecque	Mammal Observer
Leigh Torres	Mammal Observer	Michael Force	Seabird Observer
Michael Force	Seabird Observer	Cornelia Oedekoven	Seabird Observer
Cornelia Oedekoven	Seabird Observer	Pierre Malan	Oceanographer
Candice Hall	Oceanographer	Annie Douglas	Photo-ID Specialist
Shannon Rankin	Acoustician	Shannon Rankin	Mammal Observer
Paula Olson	Photo-ID Specialist		
Jessica Burtenshaw	Visiting Scientist		

DISPOSITION OF DATA:

The mammal sighting, acoustic, and oceanographic data are currently being analyzed. The final reports will be completed by January 2003.

All original marine mammal files and records were delivered to the Chief Scientist, Dr. Jay Barlow, SWFSC. Acoustic data are stored, for analysis and archive at SWFSC with the Chief Scientist.

Oceanographic data were delivered to Dr. Paul Fiedler, SWFSC for analysis and distribution.

Biopsy samples were delivered to Dr. Kelly Robertson, SWFSC for analysis and distribution.

Seabird files were delivered to Dr. Lisa Ballance, SWFSC for analysis and distribution.

Prepared by: _____

LTjg Jason Appler
Survey Coordinator, SWFSC

Dated: _____

Dr. Jay Barlow
Chief Scientist, SWFSC

Dated: _____

Approved by: _____

Dr. Michael Tillman,
Science Director, F/SWR

Dated: _____

Table 1:
Summary of Marine Mammal School Sightings by leg.

Taxon	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5	Leg 6	Total
<i>Delphinus</i> (unid. Spp.)	1	0	3	0	0	0	4
<i>Stenella coeruleoalba</i>	1	0	1	0	0	4	6
<i>Delphinus capensis</i>	0	0	0	0	2	0	2
<i>Delphinus delphis</i>	19	0	26	16	6	18	85
<i>Tursiops truncatus</i>	0	0	1	0	10	0	11
<i>Grampus griseus</i>	4	3	10	1	9	1	28
<i>Lagenorhynchus obliquidens</i>	3	6	4	1	6	4	24
<i>Lissodelphis borealis</i>	3	6	2	6	14	5	36
<i>Orcinus orca</i>	1	2		1	3	2	6
<i>Phocoena phocoena</i>	4	14	12	1	0	0	31
<i>Phocoenoides dalli</i>	32	9	32	7	10	14	104
<i>Physeter macrocephalus</i>	6	1	4	5	0	3	19
Ziphiid whale	0	0	1	2	0	2	5
<i>Ziphius cavirostris</i>	3	1		1	1	2	4
<i>Eschrichtus robustus</i>	0	0	1	0	0	0	1
<i>Berardius bairdii</i>	0	3	0	0	0	0	3
<i>Balaenoptera</i> spp.	1	2	4	1		2	2
<i>Balaenoptera acutorostrata</i>	1	0	2	1	1	2	7
<i>Balaenoptera borealis</i>	1	0	0	0	0	0	1
<i>Balaenoptera physalus</i>	6	16	7	6	4	5	44
<i>Balaenoptera musculus</i>	1		8	3	0	2	13
<i>Megoptera novaeangliae</i>	3	8	7	0	1	19	38
<i>Kogia simus/breviceps</i>	0	0	0	0	1	0	1
Unid. dolphin	2	4	4	0	4	4	18
Unid. small whale	0	1	0	0	3	3	7
Unid. whale	0	0	0	0	0	1	1
Unid. large whale	0	5	2	3	0	1	11
Unid. object	0	1	0	0	0	0	1
Total							513

Table 2:

Number of seabirds sighted during ORCAWALE 2001, listed in taxonomic order.

Common name	Scientific name	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5	Leg 6	Total
Albatrosses	Diomedidae	68	66	65	82	39	84	404
Procellariidae								
Shearwaters	<i>Puffinus</i> spp.	1787	204	636	1447	158	118	4350
Petrels	<i>Pterodroma</i> spp., <i>Fulmarus</i> spp.	83	23	12	162	142	1306	1728
Storm-petrels	Oceanitidae	906	466	5030	363	131	433	7329
Tropicbirds	Phaethontidae	2	0	3	2	1	9	17
Pelicans	Pelecanidae	0	118	181	1	5	47	352
Cormorants	Phalacrocoracidae	2	1	12	10	3	21	49
Phalaropes	Phalaropodidae	944	302	148	77	265	316	2052
Jaegers	Stercorariidae	82	71	94	33	28	41	349
Gulls	<i>Larus</i> spp.	598	469	1685	263	1081	430	4526
Terns	<i>Sterna</i> spp., <i>Gygis</i> sp., <i>Chlidonias</i> spp.	32	24	47	1	0	0	104
Auks	Alcidae	467	297	608	292	200	903	2767
Total		4971	2041	8521	2733	2053	3708	24,495

Table 3: Number of pinnipeds sighted during ORCAWALE 2001, listed in taxonomic order.

Common name	Scientific name	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5	Leg 6	Total
Northern fur seal	<i>Callorhinus ursinus</i>	1	4	3	1	0	5	14
California sea lion	<i>Zalophus californianus</i>	2	0	18	2	6	5	33
Northern elephant seal	<i>Mirounga angustirostris</i>	3	4	4	0	1	0	12
Unidentified Pinniped		3	3	1	2	0	1	10
<i>Total</i>		9	11	26	5	7	11	69

Table 4:

Summary of environmental data collected during the 2001 ORCAWALE survey aboard the NOAA Ships *David Starr Jordan* and *McArthur* .

	LEG 1	LEG 2	LEG 3	LEG 4	LEG 5	LEG 6	TOTALS
CTD casts	11	11	10	14	3	17	66
CTD chlorophyll samples	110	110	101	140	30	158	649
Surface chlorophyll samples	47	53	54	63	30	88	335
Primary productivity samples	70	70	63	91	21	117	432
Nutrient samples	121	121	111	155	33	173	714
Salinity samples	47	52	64	62	10	72	307
XBT drops	48	56	51	63	28	92	338
Bongo Tows	12	11	14	13	4	17	71

Table 5:

Days Lost to Mechanical Breakdowns

Date of Incident	Days Lost	Nature of Incident
8/7/2001	5	DSJ Port Generator disabled, port call in Astoria to repair
8/16/2001	7	DSJ Shaft bearing frozen, port call in Newport for repair
8/19 - 20/2001	0	Time of scheduled in-port
8/25/2001	5	DSJ Repair location moved to Portland dry dock
10/27/2001	4	DSJ Port Generator disabled
11/10/2001	5	DSJ Port Bearing Frozen, port call in San Diego for off-load earlier than expected
Total	27	

Table 6:

Days Lost to Weather – (Less than 20 nm of usable search effort)

Date	Leg
9/2/2001	2
9/3/2001	2
9/8/2001	2
9/9/2001	2
9/18/2001	3
10/12/2001	4
10/13/2001	4
10/14/2001	4
10/16/2001	4
10/17/2001	4
10/23/2001	4
10/30/2001	5
10/31/2001	5
11/5/2001	5
11/6/2001	5
11/7/2001	5
11/29/2001	6
12/4/2001	6
Total = 18days	

Table 7:

Hydrophone array characteristics and dates used.

Array Name	# of Elements	Frequency Sensitivity		Quality	Dates Used
		Low (Hz)	High (kHz)		
Norris	5	15	40	good	8/04; 9/03; 9/10-10/19; 10/24-11/09
High Frequency	3	500	150	good	7/30-8/02; 8/05-9/02; 9/04-9/09
SEFSC	5	15	40	good	10/20-10/23

Table 8: Number of sighted cetacean schools per leg for which acoustic recordings were obtained using a towed hydrophone array on the *Jordan* during ORCAWALE 2001, listed in order of the number of recordings obtained.

Species	Leg 1	Leg 2	Leg 3	Leg 4	Leg 5
<i>Delphinus delphis</i>	13	0	25	10	6
<i>Grampus griseus</i>	3	3	5	0	5
<i>Lissodelphis borealis</i>	2	3	1	0	6
<i>Physeter macrocephalus</i>	3	1	3	4	0
<i>Lagenorhynchus obliquidens</i>	2	3	3	1	1
<i>Tursiops truncatus</i>	0	0	1	0	5
<i>Delphinus capensis</i>	0	0	0	0	2
<i>Stenella coeruleoalba</i>	1	0	1	0	0
<i>Unidentified dolphins</i>	1	0	1	0	0
<i>Orcinus orca</i>	0	1	0	0	0
Total	25	11	40	15	25

Table 9: Number of cetacean recordings obtained using sonobouys on the *Jordan* and the *McArthur*. A total of 38 sonobuoys were launched, of which 21 were functional.

Species	Vocals	No Vocals
<i>Balaenoptera musculus</i>	7	4
<i>Megoptera noviangliae</i>	2	3
<i>Balaenoptera physalus</i>	2	0
<i>Orcinus orca</i>	2	0
Total	13	7

Figure1

ORCAWALE 2001 (Beauf 0-5)

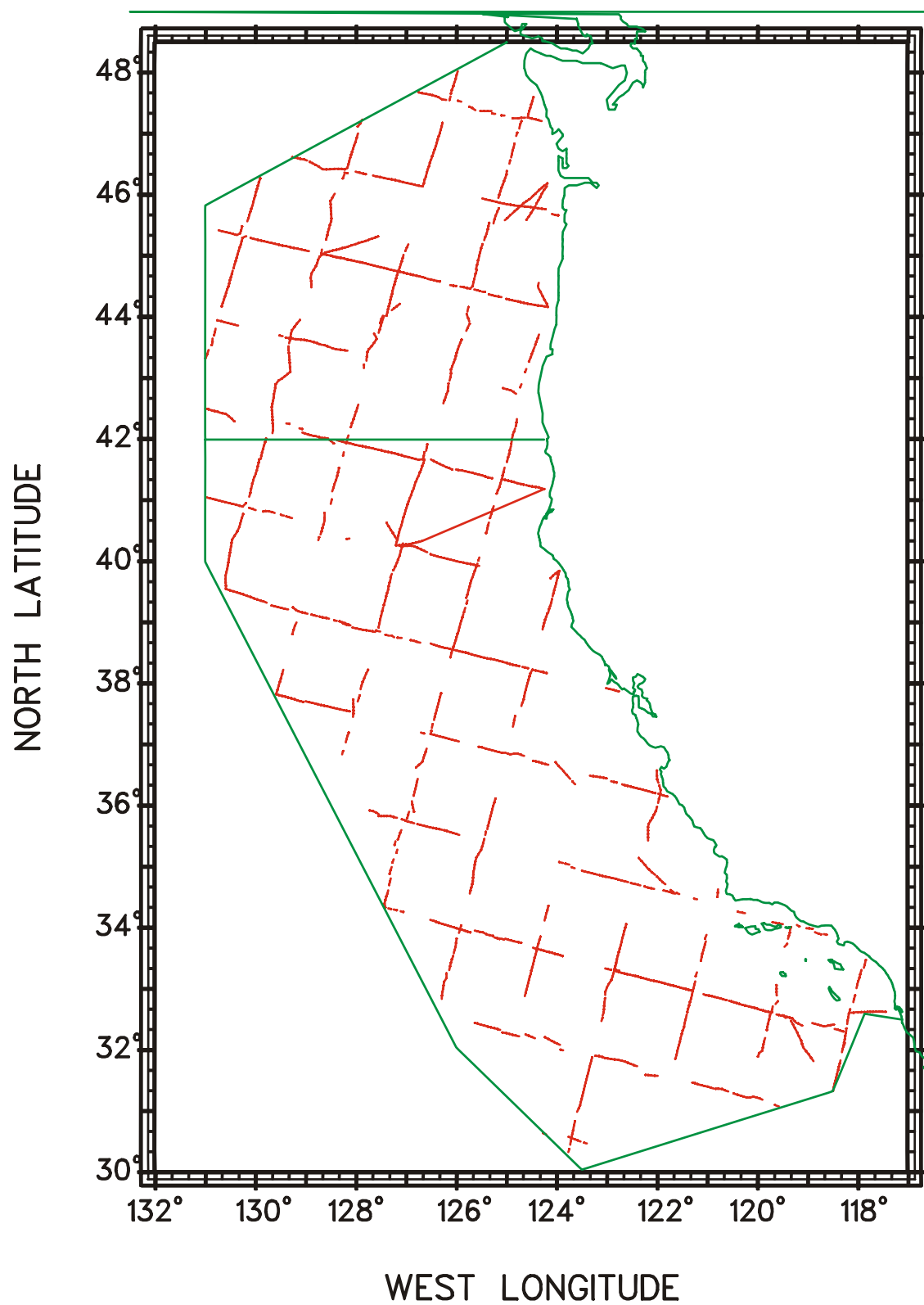


Figure 2
Proposed Tracklines

